



NUTRITIONAL AND TECHNOLOGICAL ADVANCEMENTS IN THE PROMOTION OF ETHNIC AND NOVEL FOODS USING THE GENETIC DIVERSITY OF MINOR MILLETS IN INDIA

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INTRODUCTION

Neglected and underutilized crop genetic resources are very vital for sustainable agriculture (Espinosa et al., 1999; Bhalu Mal (2007) and minor millets belong to this important group of crops (Datta et al., 2007). The important minor millets cultivated in India are finger millet (*Echinochloa crus-galli* (L.) Gaertner), kodo millet (*Paspalum scrobiculatum* L.), foxtail millet (*Setaria italica* (L.) Pers), little millet (*Pennisetum glaberrimum* Roth ex Roemer & Schultze), proso millet (*Pennisetum polystachion* L.) and barnyard millet (*Echinochloa colona* (L.) Link). These millets have remained the food for the people of the lower economic strata and traditional consumers, because of their coarse texture, characteristic flavour, intensely coloured seed coat and cultural attributes (Riley et al., 2004 and Yenagi, 2004). Culture has been an important factor in the development of ethnic and novel foods. An appropriate food processing technology stimulates agriculture production, ensures availability of quality products, value addition and helps in creating jobs. Such an approach is thus strategic in supporting both the economic progress and industrial development in rural areas of India (Yenagi, 2007). Because women are the main actors behind the economic progress and industrial development of rural areas of India (Yenagi, 2007). Because women are the main actors behind the knowledge, production and industrial development of rural areas of India (Yenagi, 2007). Because women are the main actors behind the opportunity of empowerment of this marginalized sector of the Indian society. It is under this background that the IFAD funded research project on small millet crops is being funded to pave the way for the development of indigenous opportunities for better utilization of these resources in generating value added and sustainable foods in different sectors of food industries in India.

MATERIAL AND METHODS

1. Selection of ethnic and novel foods: Products accepted by both rural and urban consumers across Karnataka State and entered in the entrepreneurial activities of women Self Help Groups (SHGs) as home based food processing activity, were selected for evaluation of nutritional and technological opportunities for better utilization in the market as compared to other products existing already in the market. Ethnic foods like mudda happa and fermented breakfast food - paddu and novel foods such as biscuits, chakali and besan laddus were selected.



2. Method of Preparation

Paddu: Prepared from fermented batter of soaked rice and blackgram dhal. Batter is poured in an oil greased iron mould and baked



Mudda happa: Prepared from three days soaked rice flour with addition of safflower flour and spice mixture. Semi solid dough is prepared and steamed for 15min. Steamed dough is kneaded till becomes soft and pressed into paddus.



Biscuits: Prepared from refined flour as per the standard procedure



Besan laddu: Prepared by roasting Bengal gram flour with addition of ghee till becomes golden brown colour. Flour is made in to laddus after the addition of powdered sugar.



Chakali: Prepared from mixture of rice flour, blackgram dhal flour and bengalgram flour. Dough is prepared and pressed into chakali

3. Evaluation of ethnic and novel foods of millets for technological and nutritional qualities:

Technological properties: The observations were recorded on weight of the dough, handling properties of the dough, weight of the end product, number of pieces obtained, weight of individual unit, time taken for cooking, yield obtained, spread ratio, expansion ratio, per cent increase in volume for the control recipe and millet based recipe as per the standard procedure.

Objective and subjective quality characteristics of products: Products prepared from the women entrepreneurs were procured and evaluated for sensory quality characteristics subjectively and objectively.

Sensory evaluation of ethnic and novel foods: Products were evaluated on nine point hedonic scale (1- very poor, 9- excellent) by a panel of ten trained members at Food Laboratory, Department of Food Science and Nutrition, College of Rural Home Science, University of Agricultural Sciences, Dharwad.

Nutrient composition of ethnic and novel foods: Selected products were assessed for nutrient composition by computation method using 'Nutritive value of Indian foods', and compared between control and millet recipes (Gopalan et al., 2004)

RESULTS AND DISCUSSION

Technological features of ethnic and novel foods of millets in comparison with standard foods are presented in Table 1 and Table 2. Significant variation was observed for most of the technological features of different millet products, viz., total weight of the end product, number of pieces obtained, spread ratio of biscuits, expansion ratio of paddus, per cent increase in the volume of baked paddu, baking/cooking/frying time, making time/grinding time of the product as compared to the respective standard products.

It is evident from Table 2 that technological features of ethnic and novel foods of millets differed significantly during different stages of processing. Time taken for grinding, baking of paddu, preparation of paddu, roasting of flour, making of laddu and frying of chakali of millet was significantly lower than the standard recipes. This may be due to the smaller size of millet grains which take lesser time for hydration and cooking.

The expansion ratio of fried paddu and spread ratio of biscuits were significantly lower than the standard recipes whereas the per cent increase in the volume of paddu was significantly higher than standard recipes. These unique technological features of millet products showed the possibility of their use as time and fuel saving grains. These technological features can replace or serve as an alternative to rice or wheat or any pulse flour in conventional or novel food preparations such as fermented foods, fried foods, and convenient foods or in bakery industries.

Fig. 1-5 show the sensory scores obtained during the study. Evaluation of ethnic and novel foods of millets as compared to standard ones revealed that the sensory scores of all the quality parameters were higher for standard recipes as compared to those made with millets. These differences are however non significant for most of the traits.

Furthermore, it is also interesting to note that though sensory scores were low for millet products for most characters, their rating scored though 7 and above, which indicated that these products were under the category of 'very good' for acceptability. The results of the study show that millet products have a potential to be widely acceptable and popularized in the national market.

The price of the main ingredient is one of the important factors for assessing the cost benefit ratio of the end product. The cost of pulse based recipe- laddu in the millet is around Rs-160-180/kg which is sensibly higher than that of millets (Rs-50/kg). Replacement of Bengal gram flour with that of millet yielded therefore a cheaper product with on par acceptability for all the sensory quality parameters (Table 3).

Similarly, the per cent increase in the volume of the paddu is one of the important quality and economic character which adds additional profit to millet products. The number of biscuits that can be prepared with a unit quantity of millet flour is also higher as compared to that produced with other flour and this gain in productivity is certainly another interesting feature that can be used for enhancing the marketing of millet-based products.

From a nutritional point of view, the ethnic and novel products of millets were found to be comparatively richer in protein and mineral content than those made out of rice or wheat (Table 4). Although, no significant difference was observed for the sensory quality characters and technological features of standard biscuits and millet biscuits, the latter were found to bear greater amounts of proteins and calcium. Such a fact represents a highly strategic element in our attempt to enhance the nutritional values of bakery products in India and deserve greater attention of policy makers and industrial sector. Indeed, since substitution of less refined millet flour to standard recipes, has improved the nutritional quality of the products by increasing macro as well as micronutrients, recipes based with small millets need to be widely popularized for combating hidden nutritional deficiencies, particularly high among school going children.

Besides their nutritional contribution, small millets also play a strategic role as instrument of empowerment for women. In the framework of the IFAD NUS project, hundreds of women were trained on preparing value-added products, of great acceptability and demand at the local level. As a result of their acquired skills, the trained women have gained greater self-confidence in their food production activities at both household and market level, with positive repercussions on their own family and communities. Furthermore, complementary training efforts in marketing food products have made some of these women, associated with SHGs, complementary by the project, also successful entrepreneurs.

Table 1. Technological features of processed ethnic and novel foods of millets during different stages of processing.

Type of food	Ethnic	Novel	Standard	Grinding			Baking			Frying		
				Time (min)	Weight (g)	Yield (%)	Time (min)	Weight (g)	Yield (%)	Time (min)	Weight (g)	Yield (%)
Biscuits	Mean	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Paddu	Mean	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Chakali	Mean	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2

* Significant ** Highly significant

Table 2. Nutritive value of ethnic and novel foods of millet during different stages of processing.

Type of food	Ethnic	Novel	Standard	Grinding			Baking			Frying		
				Protein (g/100g)	Calcium (mg/100g)	Energy (kcal/100g)	Protein (g/100g)	Calcium (mg/100g)	Energy (kcal/100g)	Protein (g/100g)	Calcium (mg/100g)	Energy (kcal/100g)
Biscuits	Mean	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Paddu	Mean	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Chakali	Mean	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2

* Significant ** Highly significant

Table 3. Mean sensory scores of ethnic and novel foods of millets in comparison to standard recipes.

Food	Ethnic	Novel	Standard	Grinding			Baking			Frying		
				Mean	SE	CV	Mean	SE	CV	Mean	SE	CV
Biscuits	Mean	7.8**	8.1**	8.1	7.8	8.0	8.0	8.0	8.0	8.0	8.0	8.0
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	6.4	6.5	6.5	6.4	6.5	6.5	6.4	6.5	6.5	6.5	6.5
Paddu	Mean	8.3**	8.3**	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Chakali	Mean	7.8**	8.1**	8.1	7.8	8.0	8.0	8.0	8.0	8.0	8.0	8.0
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	6.4	6.5	6.5	6.4	6.5	6.5	6.4	6.5	6.5	6.5	6.5

* Significant ** Highly significant *Ns- Non significant

Table 4. Nutritive value of ethnic and novel foods of millet during different stages of processing.

Type of food	Ethnic	Novel	Standard	Grinding			Baking			Frying		
				Protein (g/100g)	Calcium (mg/100g)	Energy (kcal/100g)	Protein (g/100g)	Calcium (mg/100g)	Energy (kcal/100g)	Protein (g/100g)	Calcium (mg/100g)	Energy (kcal/100g)
Biscuits	Mean	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Paddu	Mean	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Chakali	Mean	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	SE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	CV	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2

* Significant ** Highly significant

Fig. 1. Organoleptic scores for paddu

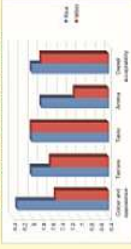


Fig. 2. Organoleptic scores for biscuits

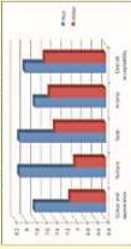


Fig. 3. Organoleptic scores for chakali

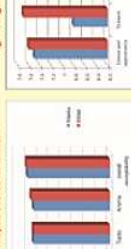


Fig. 4. Organoleptic scores for laddu

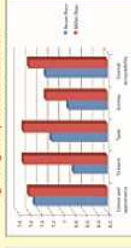
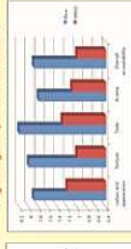


Fig. 5. Organoleptic scores for chakali



CONCLUSION

Ethnic millet papads, chakali, fermented breakfast food 'paddu', novel foods like biscuits, laddu all prepared with small millets have proven to have good scope for enhancing nutrition security, marketing and income generation of community members, particularly rural women. Value addition has also shown to be a highly strategic intervention in the popularization of nutritionally and technologically rich local crops, currently largely neglected and underutilized. As this project has demonstrated, the success and sustainability of efforts in this domain are however largely dependent upon an effective synergy among highly complementary disciplines, including crop improvement, nutrition, food technology, marketing, education, public awareness and policies.

